

## MATH 712: Numerical Methods II

### *Fall 2020 Graduate Course Syllabus*

**NJIT Academic Integrity Code:** All Students should be aware that the Department of Mathematical Sciences takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

### COURSE INFORMATION

**Course Description:** Numerical methods for the solution of initial- and boundary-value problems for partial differential equations, with emphasis on finite difference methods. Consistency, stability, convergence, and implementation are considered.

**Number of Credits:** 3

**Prerequisites:** MATH 614, MATH 331 or departmental approval, and proficiency in a computer programming language (MATLAB, C, C++, Fortran, etc.).

#### Course-Section and Instructors

Course-Section	Instructor
Math 712-001	Professor P. Petropoulos

**Office Hours for All Math Instructors:** [Fall 2020 Office Hours and Emails](#)

#### Required Textbooks:

<b>Title</b>	<i>Numerical Partial Differential Equations: Finite Difference Methods</i>
<b>Author</b>	Thomas, J.W.
<b>Edition</b>	1995
<b>Publisher</b>	Springer-Verlag New York
<b>ISBN #</b>	978-1-4419-3105-4
<b>Optional Text</b>	Finite Difference Schemes and Partial Differential Equations, by J. Strikwerda, SIAM, Philadelphia, 2004; ISBN 0-898715679 and Finite Difference Methods for Ordinary and Partial Differential Equations, by R.J. LeVeque, SIAM, 2007; ISBN 978-0898716290

**University-wide Withdrawal Date:** The last day to withdraw with a **W** is **Monday, November 9, 2020**. It will be strictly enforced.

## POLICIES

**DMS Course Policies:** All DMS students must familiarize themselves with, and adhere to, the **Department of Mathematical Sciences Course Policies**, in addition to official **university-wide policies**. DMS takes these policies very seriously and enforces them strictly.

**Grading Policy:** The final grade in this course will be determined as follows:

Homework	45%
Midterm Exam	25%
Final Exam	30%

**Attendance Policy:** Attendance at all classes will be recorded and is **mandatory**. Please make sure you read and fully understand the **Math Department's Attendance Policy**. This policy will be strictly enforced.

**Exams:** There will be one midterm exam held in class during the semester and one comprehensive final exam. Exams are held on the following days:

Midterm Exam	October 18, 2020
Final Exam Period	December 15 - 21, 2020

The final exam will test your knowledge of all the course material taught in the entire course. Make sure you read and fully understand the **Math Department's Examination Policy**. This policy will be strictly enforced.

**Makeup Exam Policy:** To properly report your absence from a midterm or final exam, please review and follow the required steps under the DMS Examination Policy found here:

- [http://math.njit.edu/students/policies\\_exam.php](http://math.njit.edu/students/policies_exam.php)

**Cellular Phones:** All cellular phones and other electronic devices must be switched off during all class times.

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## ADDITIONAL RESOURCES

**Accommodation of Disabilities:** Disability Support Services (DSS) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please contact Chantonette Lyles, Associate Director of Disability Support Services at **973-596-5417** or via email at [lyles@njit.edu](mailto:lyles@njit.edu). The office is located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Disability Support Services office authorizing your accommodations will be required.

For further information regarding self identification, the submission of medical documentation and additional support services provided please visit the Disability Support Services (DSS) website at:

- <https://www.njit.edu/studentssuccess/accessibility/>

**Important Dates** (See: **Fall 2020 Academic Calendar, Registrar**)

Date	Day	Event
September 1, 2020	T	First Day of Classes
September 5, 2020	S	Saturday Classes Begin
September 7, 2020	M	Labor Day

September 8, 2020	T	Monday Classes Meet
September 8, 2020	T	Last Day to Add/Drop Classes
November 9, 2020	M	Last Day to Withdraw
November 25, 2020	W	Friday Classes Meet
November 26-29, 2020	R - Su	Thanksgiving Recess - University Closed
December 10, 2020	R	Last Day of Classes
December 11 & 14, 2020	F & M	Reading Days
December 15 - 21, 2020	T - M	Final Exam Period

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## Course Outline

1. Review of classification of PDEs, Fourier analysis of PDEs, symbols of operators, dispersion relations, well posedness of initial-value and initial-boundary-value problems for model PDEs
2. Numerical differentiation on a grid
3. Some simple explicit & implicit Finite Difference (FD) numerical schemes for the model PDEs
4. The concepts of Order of Accuracy, Stability, Consistency and Convergence of numerical schemes
5. Fourier analysis on a grid. The Evaluation and Truncation operators.
6. Stability of single- and multi-step FD schemes. Introduction to the effect of boundary conditions
7. Dispersion and Dissipation of FD schemes
8. Schemes for Hyperbolic and Parabolic PDEs and systems in 1 and 2 dimensions
9. Stability analysis of Initial Boundary Value Problems for PDEs
10. Applications to model linear and nonlinear (Newton iteration) PDEs

*Updated by Professor P. Petropoulos- 8/21/2020  
Department of Mathematical Sciences Course Syllabus, Fall 2020*

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